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FLOOD INSURANCE STUDY

TOWN OF HEBRON, TEXAS
DENTON COUNTY

DECEMBER 5, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 481495

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: December 5, 1990

Flood Insurance Study Revised:

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	2
	2.4 Flood Protection Measures	4
3.0	ENGINEERING METHODS	4
	3.1 Hydrologic Analyses	4
	3.2 Hydraulic Analyses	6
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	6
	4.1 Floodplain Boundaries	7
	4.2 Floodways	7
5.0	INSURANCE APPLICATIONS	10
6.0	FLOOD INSURANCE RATE MAP	11
7.0	OTHER STUDIES	11
8.0	LOCATION OF DATA	12
9.0	BIBLIOGRAPHY AND REFERENCES	12

TABLE OF CONTENTS - continued

Page

FIGURES

Figure 1 - Vicinity Map 3

Figure 2 - Floodway Schematic 8

TABLES

Table 1 - Summary of Discharges 5

Table 2 - Floodway Data 9

EXHIBITS

Exhibit 1 - Flood Profiles
Indian Creek Panels 01P-04P
Dudley Branch Panels 05P-06P

Exhibit 2 - Flood Insurance Rate Map and Street Index

Exhibit 3 - Elevation Reference Marks

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Hebron, Denton County, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for Indian Creek in this study were prepared by the Forth Worth District of the U. S. Army Corps of Engineers (COE) during the preparation of the Flood Insurance Study for the unincorporated areas of Denton County. The hydrologic and hydraulic analyses for Dudley Branch in this study were prepared by Raymond L. Goodson, Jr., Inc., during the preparation of a revised Flood Insurance Study for the City of Carrollton.

1.3 Coordination

On September 21, 1988, the Town of Hebron was notified by the Federal Emergency Management Agency (FEMA) of the initiation of a Flood Insurance Study for the community.

A final Consultation and Coordination Officer's meeting was not held, despite FEMA's attempts to review the results of the study with town representatives.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Hebron, Denton County, Texas. The area of study is shown on the Vicinity Map (Figure 1).

Indian Creek and Dudley Branch were studied by detailed methods for their entire lengths within the community. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Midway Branch was studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

2.2 Community Description

The Town of Hebron is located in southeastern Denton County. It is bordered by the City of The Colony and the unincorporated areas of Denton County to the north, the City of Plano, Collin County, to the east, the City of Carrollton to the south, and the City of Lewisville to the west.

The town is drained by Indian Creek, Dudley Branch, Midway Branch, and their tributaries. The streams flow towards the southwest to their respective confluences with the Elm Fork Trinity River.

The terrain in the vicinity of the Town of Hebron is classified as Blackland Prairie. The topography is gently rolling to almost level, with narrow streams well incised. The soils in the area are primarily of the Houston Black, Haiden, and Austin series. The native vegetation consists of bunch and short grasses, with scattered mesquite trees on the uplands and hardwood, primarily elm, hackberry, and pecan, along the streams.

The climate in the town is warm, temperate, and humid. Summers are hot, and winters are short and mild. Extremes of temperature and precipitation are of relatively short duration. The mean annual precipitation is approximately 35 inches. The mean relative humidity is 63 percent, and the average annual temperature is 65.8 degrees Fahrenheit (^{o}F).

2.3 Principal Flood Problems

Most of the flood-producing storms that occur in the Hebron area are experienced in the spring and fall. Most of the more severe floods that have occurred in the general geographic region have resulted from prolonged or successive storms that produced heavy rainfall; however, severe flooding may be produced by intense local thunderstorms at any time.

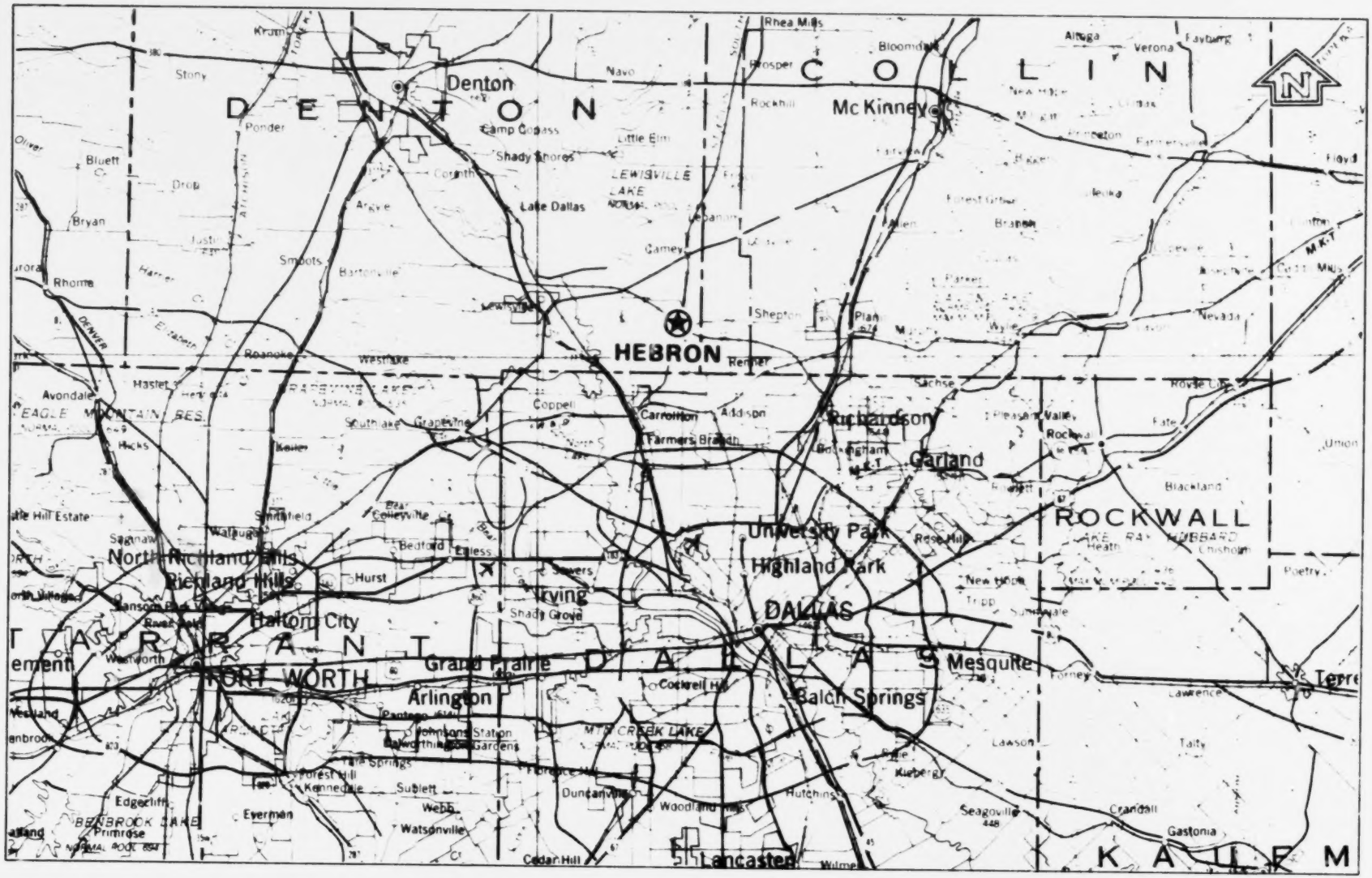


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX

(DENTON CO.)

APPROXIMATE SCALE

8 0 8 16 24 MILES

3

VICINITY MAP

2.4 Flood Protection Measures

There are no existing or planned flood protection structures in the Town of Hebron.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analyses for Indian Creek were obtained from data used in the preparation of the Flood Insurance Study for the unincorporated areas of Denton County (Reference 1).

In that study, the flood-frequency discharge values for the streams studied by detailed methods were developed using the computer program NUDALLAS (Reference 2). The watershed was divided into subbasins, and synthetic unit and flood hydrographs were developed at selected locations. National Weather Service Technical Paper No. 40 and National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NWS Hydro-35 were used in developing the 10-, 50-, and 100-year frequency storms (References 3 and 4). Peak discharge-frequency values were computed for selected locations. Routing of the flood hydrographs through each subbasin was accomplished using a modified PULS reservoir routing.

The hydrologic analyses for Dudley Branch were obtained from the Flood Insurance Study for the City of Carrollton (Reference 5). In that study, the watershed was divided into subbasins, and synthetic unit and flood hydrographs were developed at selected locations. Technical Paper No. 40 was used in developing the 10-, 50-, and 100-year storms (Reference 3). The 500-year storm was based on extrapolated data.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
INDIAN CREEK					
Approximately 5,200 feet downstream of Atchison, Topeka, & Santa Fe Railway	12.82	8,150	11,950	13,800	17,750
Approximately 1,200 feet downstream of Atchison, Topeka & Santa Fe Railway	12.06	7,800	11,350	13,050	16,800
At Burlington Northern Railroad	2.65	3,700	5,100	5,750	6,950
Approximately 2,910 feet upstream of Burlington Northern Railroad	1.39	2,100	2,900	3,250	3,900
Approximately 6,160 feet upstream of Burlington Northern Railroad	1.11	1,850	2,500	2,750	3,350
Approximately 7,170 feet upstream of Burlington Northern Railroad	0.58	950	1,200	1,400	1,700
DUDLEY BRANCH					
Approximately 2,300 feet below Hebron Parkway	0.74	1,400	1,850	2,050	2,500

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

The hydraulic analyses for Indian Creek were obtained from data used in the preparation of the Flood Insurance Study for the unincorporated areas of Denton County (Reference 1). The hydraulic analyses for Dudley Branch were obtained from the Flood Insurance Study for the City of Carrollton (Reference 5).

Cross sections for the backwater analyses were field surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 6). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Channel roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection of the floodplain areas and on previous studies by the COE. The channel "n" values for the streams studied by detailed methods ranged from 0.045 to 0.090, and the overbank "n" values ranged from 0.055 to 0.110.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet (Reference 7).

For the stream studied by approximate methods, the 100-year floodplain boundaries were delineated using the topographic maps referenced above, the Flood Hazard Boundary Map for the Town of Hebron, and the Flood Insurance Study for the unincorporated areas of Denton County (References 7, 8, and 1).

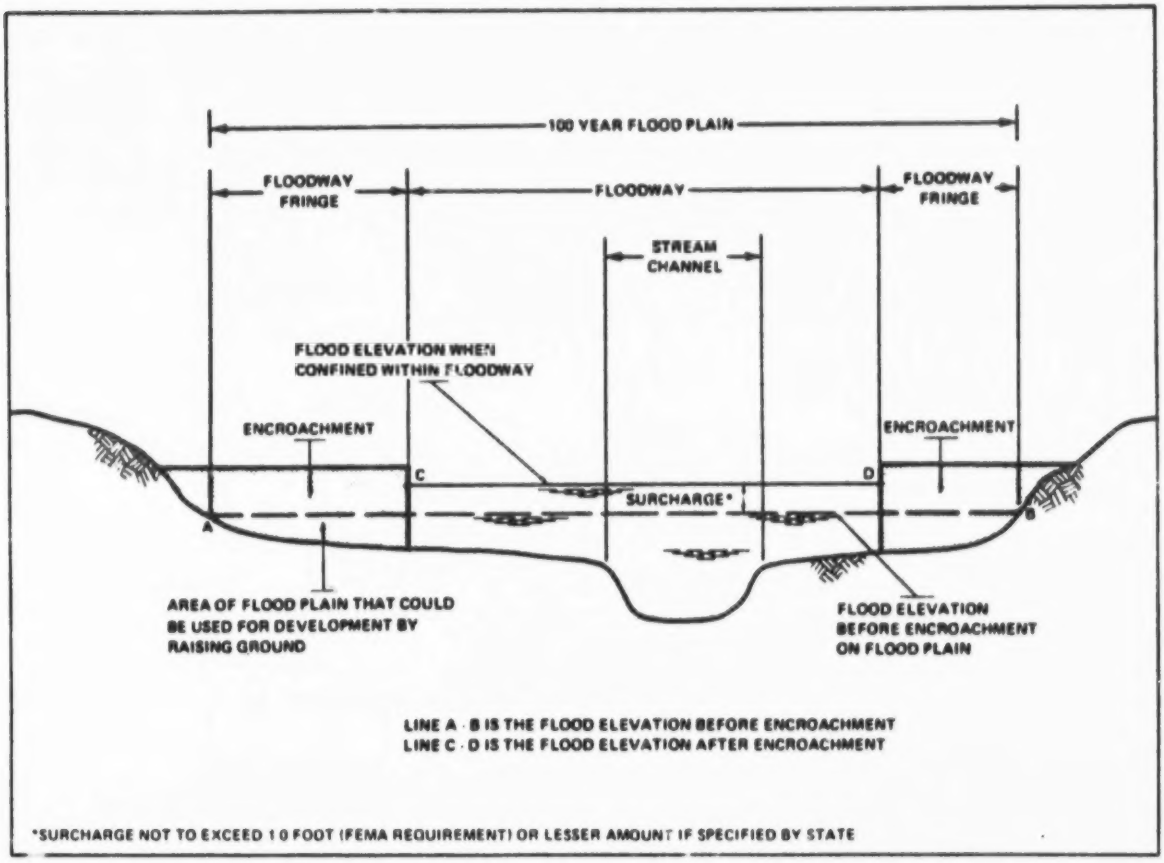
The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for Indian Creek and Dudley Branch extend beyond the corporate limits. Floodway data for Indian Creek were taken from the Flood Insurance Study for the unincorporated areas of Denton County; floodway data for Dudley Branch were taken from the Flood Insurance Study for the City of Carrollton (References 1 and 5).

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Floodway Schematic - Figure 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Indian Creek								
A	18,180	550	4,334	3.1	476.5	476.5	476.9	0.4
B	21,200	630	3,441	3.9	479.4	479.4	480.4	1.0
C	23,970	730	3,728	3.7	483.5	483.5	484.5	1.0
D	27,220	1,000	6,012	2.3	489.7	489.7	490.4	0.7
E	32,460	500	4,186	2.6	504.6	504.6	505.4	0.8
F	38,340	300	2,329	4.7	512.9	512.9	513.3	0.4
G	41,480	375	2,609	4.8	520.9	520.9	521.6	0.7
H	44,030	500[2]	3,720	3.3	529.1	529.1	530.0	0.9
I	47,300	480[2]	2,437	3.1	536.3	536.3	537.0	0.7
J	49,430	449	2,265	3.4	544.0	544.0	544.8	0.8
K	52,990	350	1,400	5.4	556.6	556.6	557.2	0.6
L	55,920	100	878	6.5	571.3	571.3	571.7	0.4
M	59,470	100	637	5.1	589.9	589.9	590.8	0.9
N	61,950	90	457	3.1	618.8	618.8	619.0	0.2
Dudley Branch								
A	23,540	74	364	8.8	529.9	529.9	530.8	0.9

[1]Feet above confluence with the Elm Fork Trinity River
[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX
(DENTON CO.)

FLOODWAY DATA

INDIAN CREEK - DUDLEY BRANCH

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies are currently being prepared for the City of Carrollton, and Collin County and Incorporated Areas (References 5 and 9). The results of those studies will be in exact agreement with the results of this study.

Flood Insurance Studies have been prepared for the unincorporated areas of Denton County, and the Cities of The Colony and Lewisville (References 1, 10 and 11). The results of this study are in exact agreement with the results of those studies.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Town of Hebron (Reference 8).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Federal Regional Center, 800 North Loop 288, Denton, Texas 76201-3698.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Denton County, Texas, Washington, D. C., September 14, 1990.

2. U. S. Army Corps of Engineers, Fort Worth District, Computer Program NUDALLAS, Fort Worth, Texas, September 1982.

3. U. S. Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, Washington, D. C., 1961, Revised 1961.

4. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Technical Memorandum NWS Hydro-35, Five to Sixty Minute Precipitation Frequency for the Eastern and Central United States, Asheville, North Carolina, National Climatic Center, June 1977.

5. Federal Emergency Management Agency, Flood Insurance Study, City of Carrollton, Denton and Dallas Counties, Texas (Unpublished).

6. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

7. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Hebron, Texas, 1960, Photorevised 1968 and 1973.

8. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Town of Hebron, Denton County, Texas, July 3, 1979.

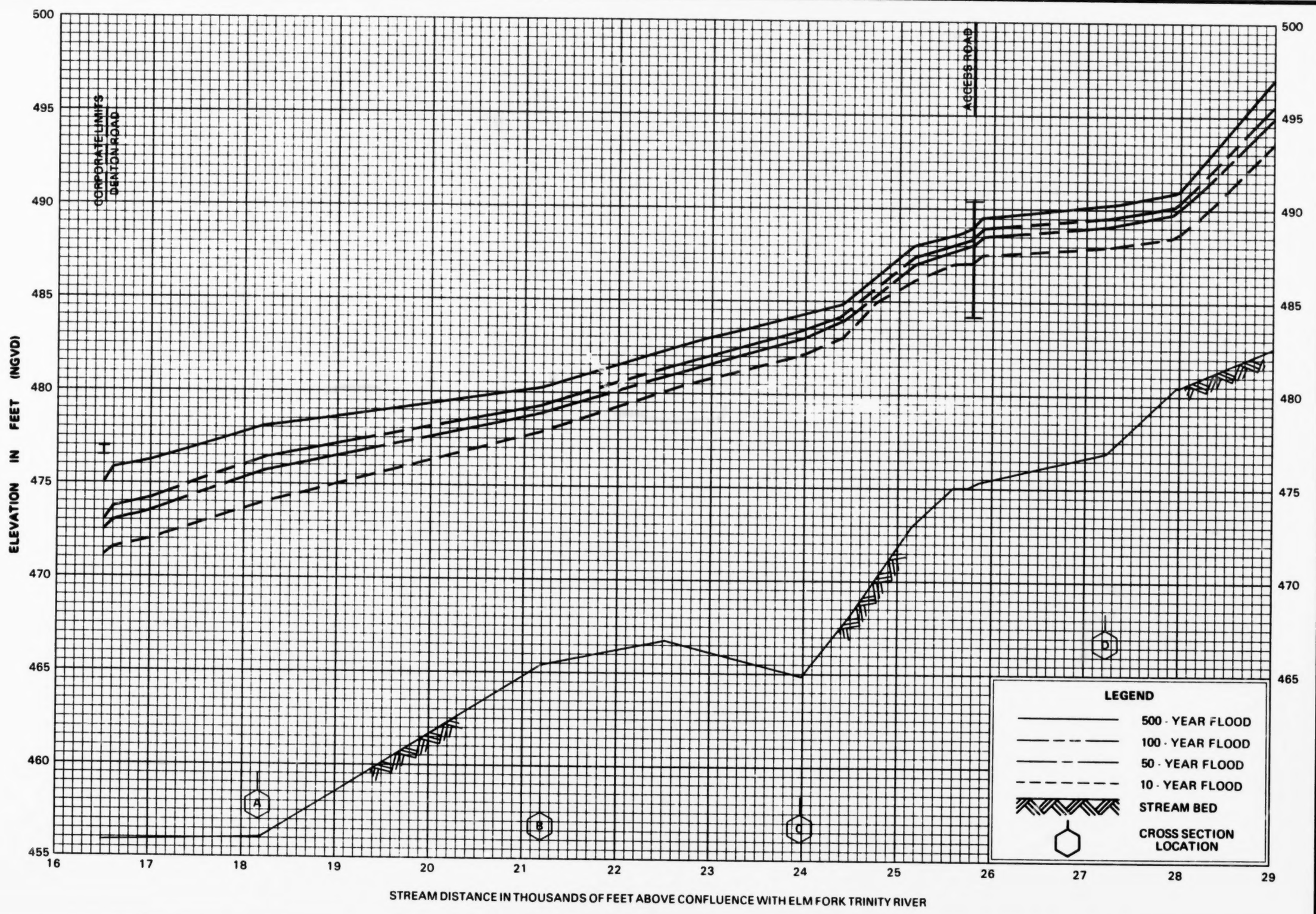
9. Federal Emergency Management Agency, Flood Insurance Study, Collin County and Incorporated Areas, Texas (Unpublished).

10. Federal Emergency Management Agency, Flood Insurance Study, City of the Colony, Denton County, Texas, Washington, D. C., September 29, 1986.

11. Federal Emergency Management Agency, Flood Insurance Study, City of Lewisville, Denton County, Texas, Washington, D. C., October 18, 1988.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (Feet NGVD)	Description of Location
RM 1	502.49	Chiseled square on northeast corner of concrete guardrail on State Route 544, approximately 250 feet west of intersection with State Route 423.
RM 2	572.91	Top railroad square in wooden abutment at southeast corner of wood trestle of Burlington Northern Railroad over Indian Creek.



FLOOD PROFILES

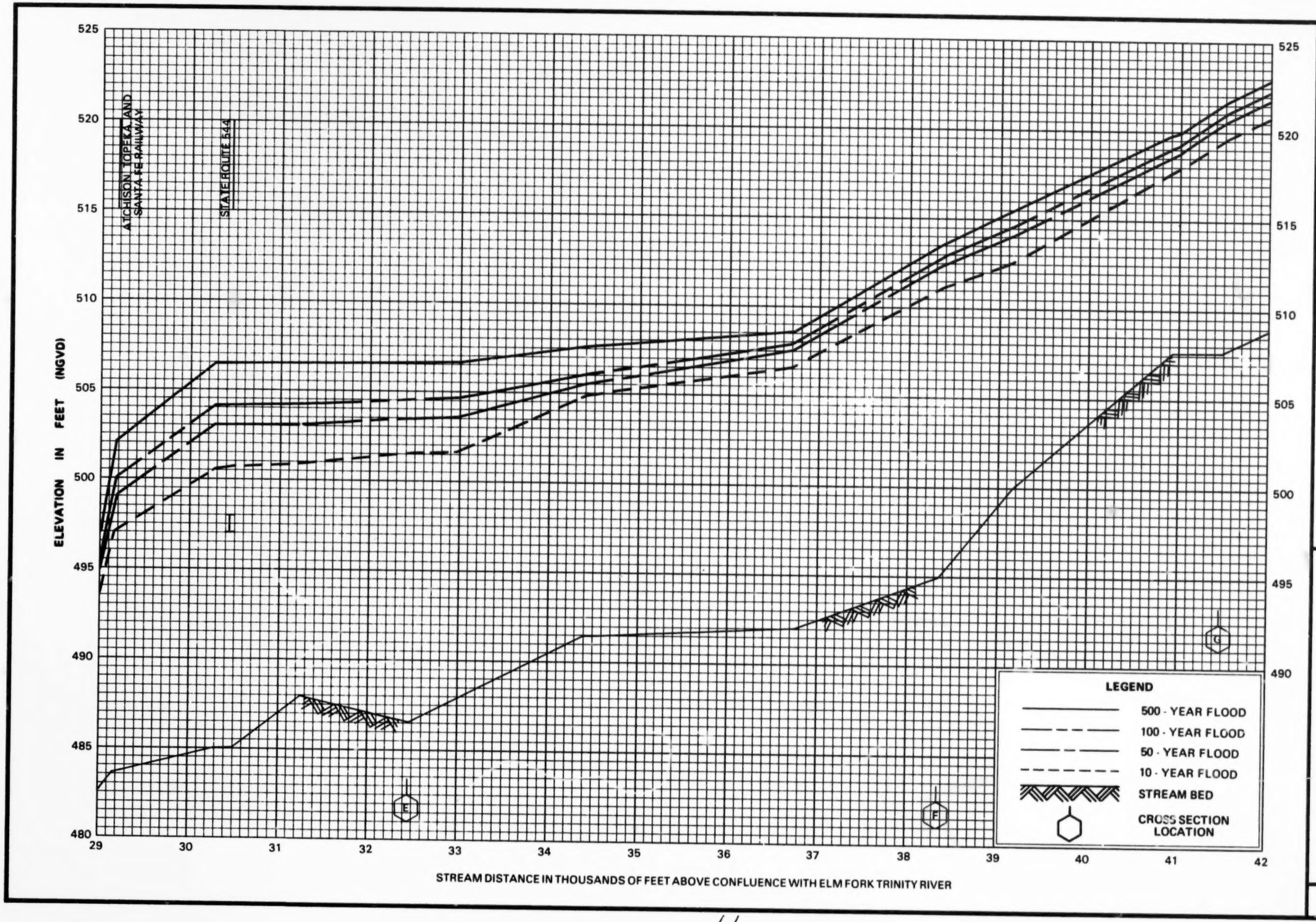
INDIAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX

(DENTON CO.)

01P



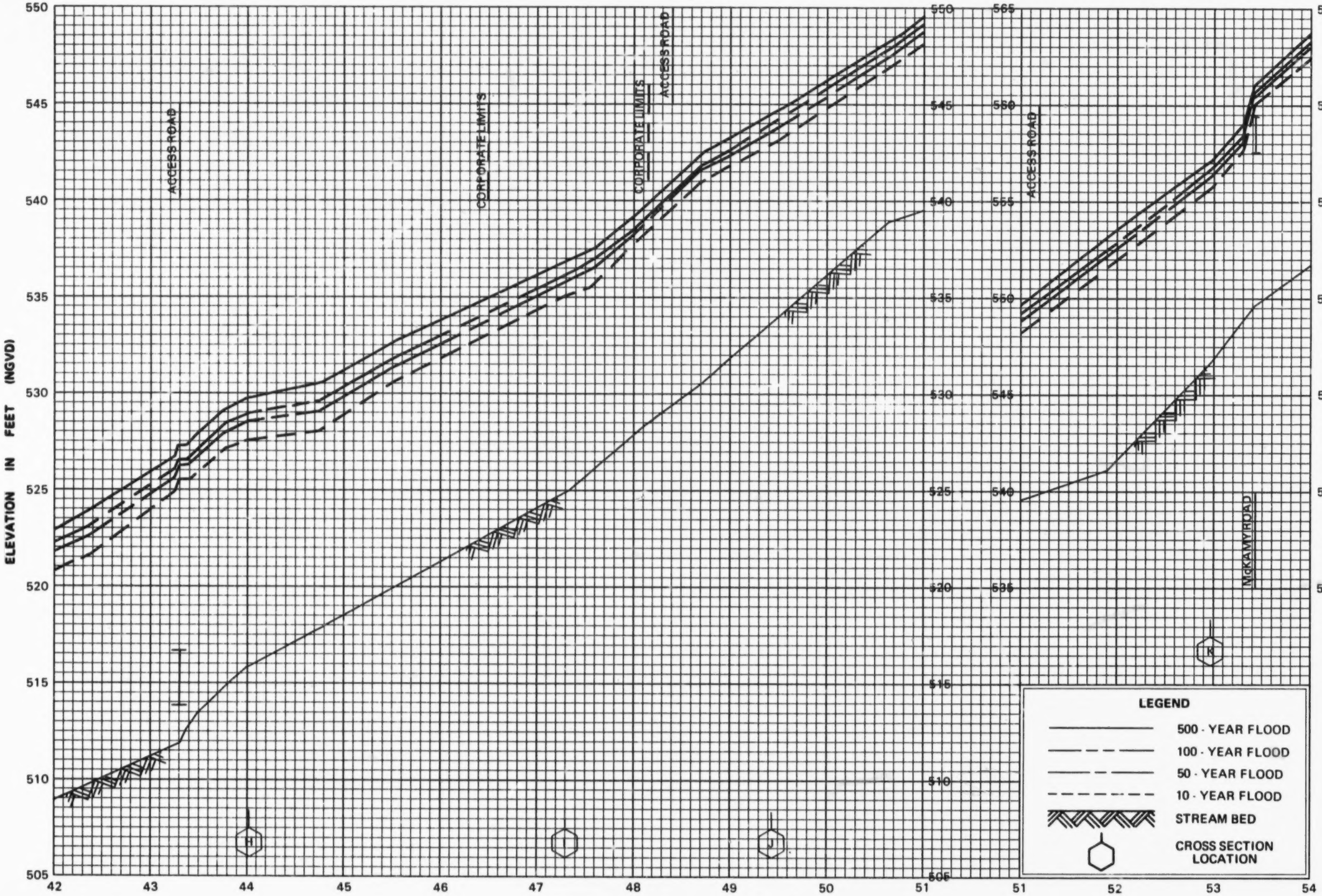
FLOOD PROFILES

INDIAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX
(DENTON CO.)

02P



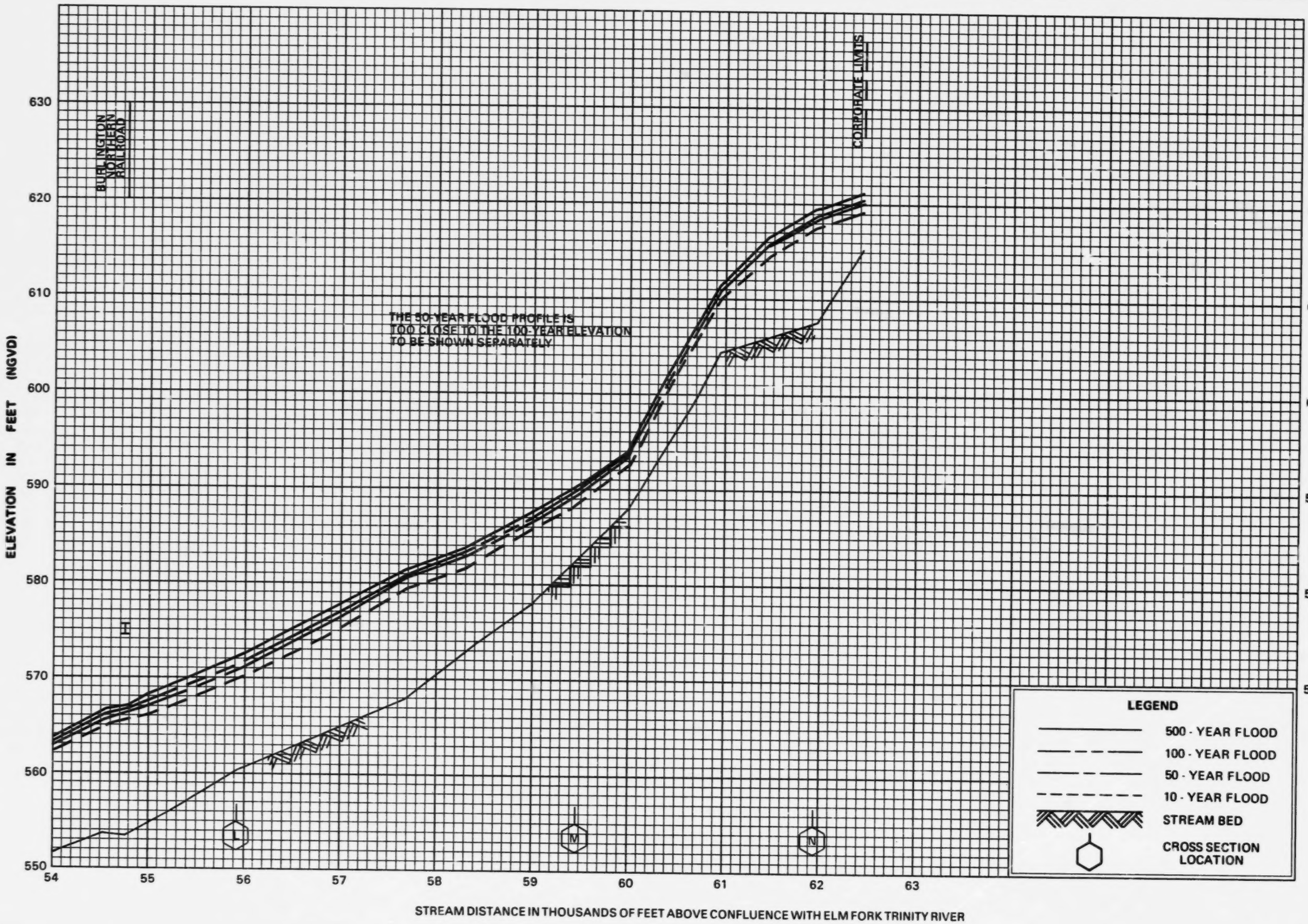
FLOOD PROFILES

INDIAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX
(DENTON CO.)

03P



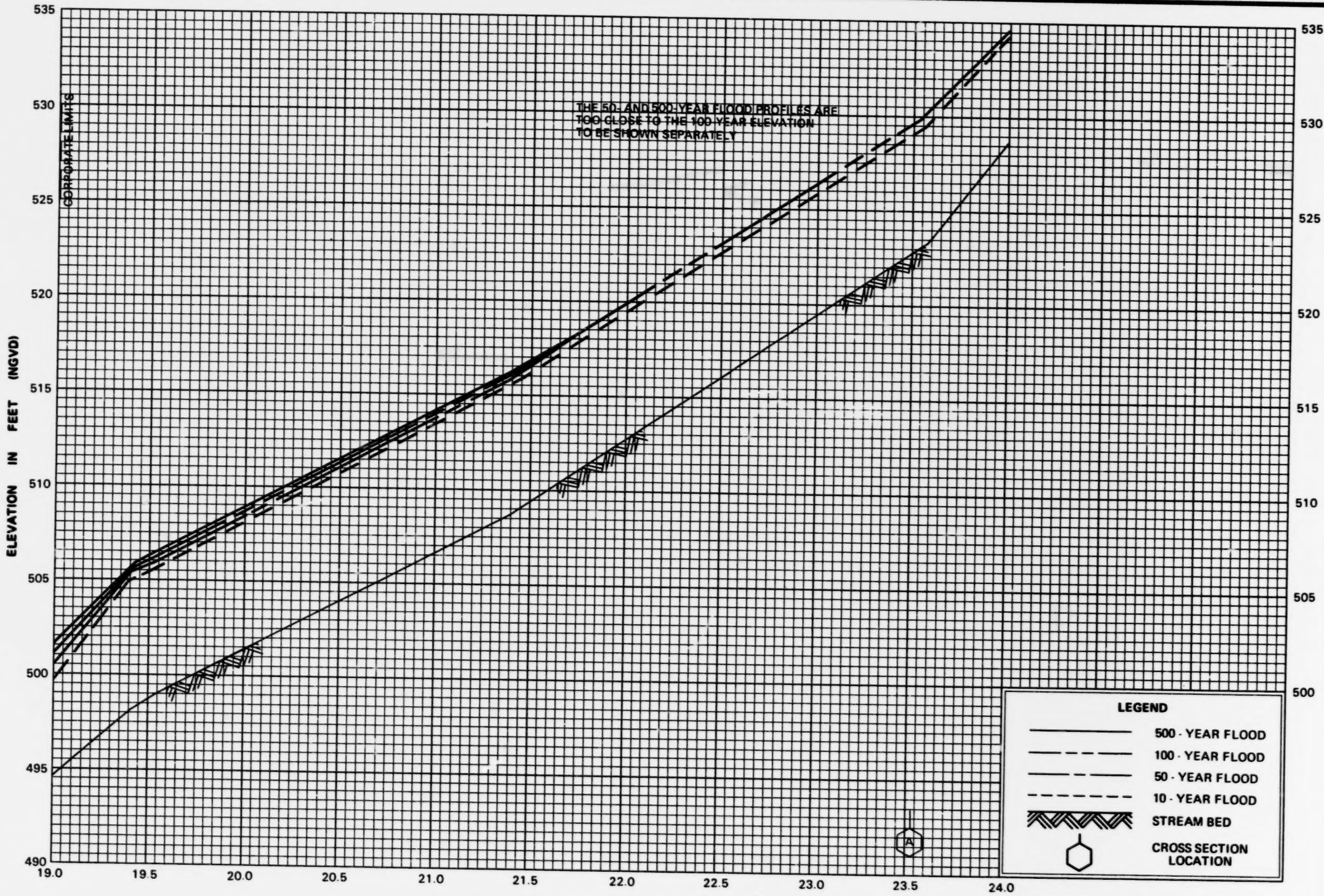
FLOOD PROFILES

INDIAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX
(DENTON CO.)

04P



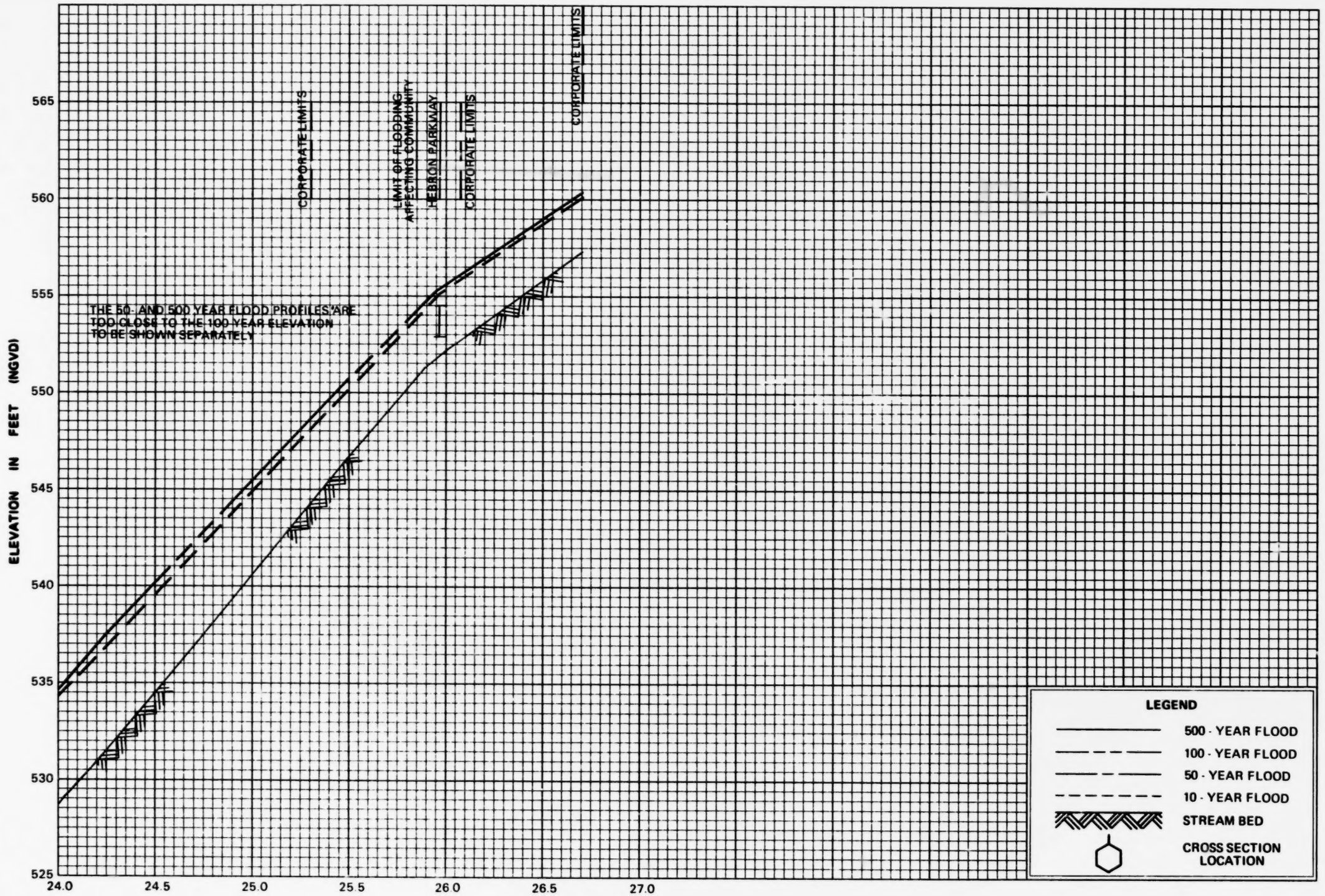
FLOOD PROFILES

DUDLEY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX
(DENTON CO.)

05P



FLOOD PROFILES

DUDLEY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF HEBRON, TX
(DENTON CO.)

06P